Listening to music postoperatively as part of pain management?

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ABSTRACT

Music has been successfully used for pain management with its proposed mechanism of action arising from endorphin release. In elderly orthopaedic patients it may reduce opioid related complications and result in earlier mobilisation, easier dressing changes and reduced length of stay. This paper systematically searched the literature for research on music as a post-operative analgesic in an orthopaedic setting. Eight articles were identified with seven reporting music as beneficial for pain management and one reporting no effect. Other benefits reported were decreased anxiety and opioid use, and improved ambulation and mental state. With joint arthroplasty rates rising, music, unobtrusive and free from side effects, may be a pain management tool worth trialling. Practicalities of implementation are discussed.

INTRODUCTION

Music is used every day to create an atmosphere conducive to relaxation, sleep, concentration or celebration. Historically, Pythagoras used harmonic music to soothe people and cure ailments and termed it "musical medicine".[1] Florence Nightingale noted that music with a continued harmony, performed either by voice or instrument, had a beneficial effect on patients' wellbeing.[1] Three Cochrane reviews have concluded that preoperative music reduces anxiety with some studies reporting it to be as effective as midazolam.[2]

A meta-analysis of post-operative pain management following major surgery, including abdominal, major gynaecological, orthopaedic and thoracic surgery, revealed the incidence of fair or poor pain relief was 23%.[3] Poor pain management post-operatively is linked with increased complication rates, while better pain management in the first 5 days post-operatively is linked to earlier mobilisation and fewer temperature spikes after total joint arthroplasty.[4,5] In an orthopaedic trauma setting, neck of femur fractures in the elderly are associated with reduced mobility, high morbidity, and these patients are particularly susceptible to the side effects of stronger analgesics.[6] If music is able to reduce post-operative pain and/or anxiety in patients, its benefits may include fewer analgesia complications and investigations for temperature spikes, as well as earlier mobilisation, improved patient experience, reduced length of stay, and potentially lower medical costs.

This article will first provide a background for the rationale of music as a tool for post-operative pain management, and then use a systematic search to specifically address research in an orthopaedic population. The aim is to elucidate what effect, if any, music has in orthopaedic post-operative pain management and in what ways it could be implemented.

BACKGROUND

Mechanism of action

Music is thought to enact its effect on pain and anxiety through auditory neural pathways which inhibit pain signals passing via the thalamus to the amygdala.[7] This both distracts the participant from the unpleasant situation and improves mood through the release of endorphins.[8] Endorphins then act on the periventricular and periaqueductal grey matter which amplifies descending inhibition of pain in a similar way to opiates. The neural auditory pathway also leads to the hypothalamus which influences the hippocampus and the anterior cingulate cortex to enhance relaxation and distraction.[7,9]

The question is often posed if it is the effect from the music *per se*, or its vibrations. In one study, mice were given heart transplants from an unrelated, non-matched mouse to produce a transplant rejection. For a week following the operation, the mice, 5 in each group, continuously listened to either opera, a selection of Mozart concertos, music by Enya, or a range of single monotones. Mice exposed to opera survived an average of 26 days, Mozart 20 days, Enya 11 days which was statistically significantly longer than the monotone group which survived for an average of 7 days. To ensure the effect was from the music and not vibrations, another group of deaf mice were transplanted from non-matched mice and then exposed to the opera music. These mice survived only 7 days.[10] This highlights the role of the harmony of music.

Previous research

Early research was done in cardiothoracic surgery. The effect of music and rest on coronary artery bypass graft (CABG) patients on post-operative day 1 was studied by Voss *et al*. There were three randomly assigned groups: group 1 listened to 30 minutes of music (n=19), group 2 had a scheduled rest period (n=21), and group 3 had treatment as usual (n=21). Using visual scales from 0-100 for pain and anxiety, statistical analysis compared pre and post intervention scores. Music significantly decreased mean anxiety, pain sensation, and pain distress scores by 50, 28, 40 points respectively compared to non-significant changes in the rest, and control groups.[11]

However, when investigating physiological measures as well as pain the results are relatively equivocal. A repeated-measures randomized controlled trial studied the effect of both 30 minutes of music and 30 minutes of rest or 60 minutes of uninterrupted rest on post-operative day 1 in 58 patients who had undergone CABG or aortic valve replacement. There were significantly lower cortisol levels in the music group (484 mmol/L) compared to the rest only group (618 mmol/L).[12] However measures of pain, heart rate, respiratory rate and anxiety levels while supporting music as beneficial failed to reach significance. The authors concluded the stringent statistical methods, low participant numbers and low baseline states of anxiety in both groups may have masked the practical benefits observed during data gathering.[12]

Good *et al*., conducted the largest randomized control trial in which 500 major abdominal surgical patients used either music, relaxation, a combination of music and relaxation, or none of these (control group) to determine their effect on post-operative pain at rest and with ambulation on post-operative days 1 and 2. There was significantly less pain in the three treatment groups when compared to the control group at all time points.[3] Further division of participants into gynaecological or general surgical procedures revealed that regardless of surgical procedure type pain scores for music, relaxation or a combination of both were all lower compared to the control group.[14,15]

A 2015 meta-analysis pooled data from 73 trials (6,902 surgical patients), investigating music use before, during or after surgery. Compared with patients who were not played music, those who were, reported experiencing less pain and anxiety following surgery. They were also less likely to need pain medication. In addition, music appeared to increase patients' overall satisfaction after surgery.[16] Some of the differences, e.g. 0.77 less on a 1-10 pain scale, while statistically significant may be less clinically significant, although the authors final conclusion was music should be available to all patients undergoing operative procedures.

A 2006 Cochrane review initially concluded that post-operative music use reduced pain intensity by 0.5 units (95% CI: -0.9 to -0.2) more on a 0-10 scale than control participants, with a number needed to treat of 5. While opioid requirements immediately post-operatively and 24 hours post-operatively were 18.5% and 15.4% less respectively in music vs control groups. The final conclusion was that the decrease was small and that music should not be the primary method of pain relief.[17] However, this report was withdrawn in 2011 stating a new one was due out in 2013.[18] To date there is no record of this review being published.

The strength of the above results vary like the experimental design and there is no large study completed to date. However, overall, the evidence lends support to music's potential use post-operatively to improve pain and anxiety and to a lesser degree reduce medication use. This article will investigate if such findings been replicated in an orthopaedic population and if so, how music could be implemented as part of post-operative management?

METHOD

A systematic search was performed using the Medline, Embase, Web of Science, Cochrane and Scopus databases. The search terms "music OR music therapy", AND "post-operative OR surgery OR orthopaedic OR orthopedic OR recovery", AND "pain OR analgesia", were used. Articles were scanned by title for relevance. Reference lists and articles recommended by the online databases were also scanned for publications. Articles were limited to the English language. A narrative review of these papers is presented.

RESULTS

The search identified eight peer-reviewed articles. Seven studies reported positive benefits of music such as reduced pain, anxiety and opioid use and improved ambulation and mental state.[8, 19-24] One study reported no differences between a music intervention and control group.[25] Six studies investigated patients undergoing knee arthroplasty, four hip arthroplasty, one spinal surgery, and one a combination of spinal, joint, and trauma surgeries. Studies were heterogenic in their methodologies as to the timing and type of music as well as to comparisons and controls (discussed below). To measure pain, four used a 0-10 visual analogue scale[19, 20, 23, 24] and one a 0-100 scale[25], one used a 0-10 brief pain index[8], one used nurses notes to measure episodes of confusion,[22] while another used the Mini Mental State Exam.[21]

Pellino *et al*., provided a kit of non-pharmacologic strategies for pain and anxiety management containing music and instructions on relaxation exercises was given to 33 patients who underwent elective total hip or knee arthroplasty.[8] The control group of 32 patients received no kit and treatment as normal. Post-operatively day 1 there was no difference in pain or medication use between the groups, while on day 2 pain measures were the same but opioid use was 68% lower in the experimental group.[8]

In a series of studies, McCaffrey and Locsin, demonstrated a reduction in pain medications, pain scores, confusion, improved ambulation and better mental state scores in patients 59 years or older undergoing elective total hip or knee arthroplasty.[21-23] Half were automatically played music for 1 hour four times a day starting from when the patient was first conscious from the anaesthesia, while half received no music. The music group took significantly fewer (12%) pain medications post-operatively than the control group. The significantly different mean pain scores (0-10 scale) on days 1, 2 and 3 were 7.8, 6.2, and 4.6 respectively in the music group, and 8.9, 8.2, and 7.4 in the control group. Music listeners walked 30-40% further each day, and only 2 music listeners experienced confusion, while 36 of the control group did.[23] This finding was further investigated in a similar experiment and the music listeners scored significantly better on Mini Mental State Exams and acute confusion scales.[21] The papers concluded that for patients aged 59 years or older, music reduced pain, increased ambulation and reduced confusion during the first three post-operative days.[21-23]

Allred *et al*., had 28 patient's listen to music for 20 minutes before and after the first ambulation following and total knee arthroplasty and found no differences compared 28 patients who had periods of quiet rest. This study measured pain, anxiety, morphine use, heart rate, respiratory rate, oxygen saturation and blood pressure.[25] Pain and anxiety scores in the music groups ranged from 36 – 52 and 27-36 respectively, while in the control group the range was 36-46 and 22-34 respectively.

Masuda *et al*., showed music proved effective as immediate and short term pain relief for orthopaedic patients over 60 years old having undergone either spinal, joint or trauma surgery. Listening to music for 20 minutes in a quiet room vs 20 minutes relaxing in a quiet room was investigated in 44 patients. On a 0-100 scale, the experimental group reported pain decreased from 82 to 59 after the 20 minutes which was significantly less than the decrease from 85 to 72 in the control group.[20]

The most recent study by Lin *et al*., investigated patients undergoing spinal surgery.[19] Thirty patients listened to music *ad libitum* from the evening before surgery to the second day after surgery and the control group of 30 did not. Measures were taken from one hour post-operative until the end of day two. On 0-10 scales pain and anxiety scores were significantly lower in the music group compared to the control group at all times. The mean anxiety scores in the music group were 0.8-2.0, compared with 2.1-5.1 in the control group. The mean pain scores in the music group were 1.7-3.0, compared with 4.4-6.0 in the control group. Non-significant trends were seen for lower heart rates, urine cortisol and adrenaline in the music group as well.[19]

Finally, Simcock *et al*., showed a selection of music played intra-operatively influenced post-operative pain. Patient selected music was played intraoperatively during total knee arthroplasty under spinal anaesthesia

and produced a significant reduction in self-reported pain 3, 6, and 24 hours after surgery in 15 patients when compared to 15 control patients who had no music.[24]

DISCUSSION

This systematic search uncovered eight articles on post-operative pain management and the use of music in an orthopaedic setting. Seven reported music as beneficial, while one reported music as being no different to a control group.

The research to date provides support for, but does not definitively prove the efficacy of post-operative music for pain management. There have been no studies with a follow-up longer than 3 days or looking at the wider benefits of improved pain management, namely, earlier or better experiences with mobilisation, reduced complication rates or fewer post-operative temperature spikes. Generally studies in a variety of surgical settings have reported that post-operative music and/or undisturbed rest on days 1 to 3 is successful as a form of immediate and basal pain or anxiety management.[16] Meanwhile music has also been shown to reduce opioid medication use, cortisol levels, and confusion, while improving sleep and ambulation.[17, 23]

Information about the effectiveness of music from reviews, intervention studies and randomised controlled trials will probably never be able to definitively answer questions about whether individual patients should try it. A conclusion drawn by many reviews and research articles is that the safety, tolerability and freedom from side effects of music means that encouraging patients to listen to music to try to alleviate their pain is a safe option. The transplant mice study demonstrates the effect of music is more than just vibrations and seven of the eight studies show music was better the control, which essentially is quiet rest. Music can therefore can be considered as an adjunct to current post-operative pain management practices due to some good evidence of its utility combined with its unobtrusiveness, safety, and freedom from side effects.

LIMITATIONS

There is language bias in this review as both German and Japanese researchers have been involved in this area with some of their articles not written in English. Overall, studies did not have adequate sample sizes and lacked sample size calculations which lead to trends for physiological effects but no significant results. Also, the description of randomization was poor or non-existent in studies. None of the studies were blinded for participants or researchers. This is essentially impossible, however, because of the intervention. Most studies used the 1-10 visual pain scale though some used 1-4 scales which makes comparison between studies more difficult and would also make measuring a significant difference more difficult.

PRACTICAL IMPLICATIONS

The music found to be most beneficial for pain relief is non-lyrical, continuous in harmony, approximately 60-80 beats per minute and at a maximum of 60 dB.[26] Music styles such as classical, new-age and meditation are reported optimal whereas heavy metal or techno music have been reported as ineffective or increasing in stress.[27] Both a meta-analysis and Cochrane review recommended patients select their preferred option from a research proven selection.[2,16] A minimum of 30 minutes duration is recommended though there is scant evidence to substantiate this.[16, 26]

A practical way to trial music's use would be to provide patients with the option of wireless headphones with preloaded music and to include a small blurb in the pre-operative information pamphlet outlining this option and the reasons behind introducing music in the clinical settings. Medical students and first year house officers are in a prime position to encourage patients to listen to music using their cell phone or MP3 players.

REFERENCES

1. White JM.
Music as intervention: a notable endeavor to improve patient outcomes.
Nursing Clin North Am. 2001;36(1):83-92.

2. Bradt J, Dileo C, Shim M.
Music interventions for preoperative anxiety.
Cochrane Database Syst Rev. 2013;6:Cd006908.

3. Dolin SJ, Cashman JN, Bland JM.
Effectiveness of acute postoperative pain management: I. Evidence from published data.
Br J Anaesth. 2002;89(3):409-23.

4. Apfelbaum JL, Chen C, Mehta SS, *et al.*
Postoperative Pain Experience: Results from a National Survey Suggest Postoperative Pain Continues to Be Undermanaged.
Anesth Analg. 2003;97(2):534-40.

5. Karam J, Zmistowski B, Restrepo C, *et al.*
Fewer Postoperative Fevers: An Unexpected Benefit of Multimodal Pain Management?
Clin Orthop Relat Res. 2014;472(5):1489-95.

6. Fergus L, Cutfield G, Harris R.
Auckland City Hospital's ortho-geriatric service: an audit of patients aged over 65 with fractured neck of femur.
NZ Med J. 2011;124(1337):40-54.

7. Shertzer KE, Keck JF.
Music and the PACU environment.
J Perianesth Nurs. 2001;16(2):90-102.

8. Pellino TA, Gordon DB, Engelke ZK, *et al.*
Use of Nonpharmacologic Interventions for Pain and Anxiety After Total Hip and Total Knee Arthroplasty.
Orthopaedic Nursing. 2005;24(3):182-90.

9. Chanda ML, Levitin DJ.
The neurochemistry of music.
Trends Cogn Sci. 2013;17(4):179-93.

10. Uchiyama M, Jin X, Zhang Q, *et al.*
Auditory stimulation of opera music induced prolongation of murine cardiac allograft survival and maintained generation of regulatory CD4+CD25+ cells.
J Cardiothorac Surg. 2012;7(1):1-8.

11. Voss JA, Good M, Yates B, *et al.*
Sedative music reduces anxiety and pain during chair rest after open-heart surgery.
Pain. 2004;112(1-2):197-203.

12. Nilsson U.
The effect of music intervention in stress response to cardiac surgery in a randomized clinical trial.
Heart & Lung: The Journal of Acute and Critical Care. 2009;38(3):201-7.

13. Good M, Stanton-Hicks M, Grass JA, *et al.*
Relief of postoperative pain with jaw relaxation, music and their combination.
Pain. 1999;81(1-2):163-72.

14. M, Anderson GC, Ahn S, *et al.*
Relaxation and music reduce pain following intestinal surgery.
Res Nurs Health. 2005;28(3):240-51.

15. Good M, Anderson GC, Stanton-Hicks M, *et al.*
Relaxation and music reduce pain after gynecologic surgery.
Pain Manag Nurs: 2002;3(2):61-70.

16. Hole J, Hirsch M, Ball E, Meads C.
Music as an aid for postoperative recovery in adults: a systematic review and meta-analysis.
The Lancet. 2015;386(10004):1659-71.

17. Cepeda MS, Carr DB, Lau J, *et al.*
Music for pain relief.
Cochrane Database Syst Rev. 2006(2):Cd004843.

18. Cepeda MS, Carr DB, Lau J, *et al.*
Music for pain relief.
Cochrane Database Syst Rev. [Internet]. 2013; (10:CD004843). Available from: http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD004843.pub3/abstract.

19. Lin PC, Lin ML, Huang LC, *et al.*
Music therapy for patients receiving spine surgery.
J Clin Nurs. 2011;20(7-8):960-8.

20. Masuda T, Miyamoto K, Shimizu K.
Effects of Music Listening on Elderly Orthopaedic Patients During Postoperative Bed Rest.
Nord J Music Ther. 2005;14(1):4-14.

21. McCaffrey R.
The effect of music on acute confusion in older adults after hip or knee surgery.
Applied Nursing Research. 2009;22(2):107-12.

22. McCaffrey R, Locsin R.
The effect of music listening on acute confusion and delirium in elders undergoing elective hip and knee surgery.
J Clin Nurs. 2004;13:91-6.

23. McCaffrey R, Locsin R.
The Effect of Music on Pain and Acute Confusion in Older Adults Undergoing Hip and Knee Surgery.
Holist Nurs Pract. 2006;20(5):218-24.

24. Simcock XC, Yoon RS, Chalmers P, *et al.*
Intraoperative music reduces perceived pain after total knee arthroplasty: a blinded, prospective, randomized, placebo-controlled clinical trial.
J Knee Surg. 2008;21(4):275-8.

25. Allred KD, Byers JF, Sole ML.
The Effect of Music on Postoperative Pain and Anxiety.
Pain Manag Nurs. 2010;11(1):15-25.

26. Nilsson U.
The Anxiety- and Pain-Reducing Effects of Music Interventions: A Systematic Review.
AORN J. 2008;87(4):780-807.

27. Trappe HJ.
Music and health--what kind of music is helpful for whom? What music not?
Dtsch Med Wochenschr (1946). 2009;134(51-52):2601-6.